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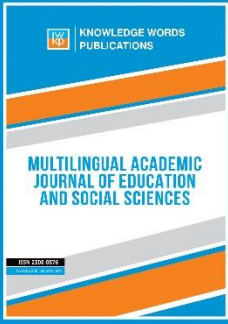
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Children's Curiosity Finds Solutions for Energy: A Project for Renewable and Non-Renewable Energy Sources for Early Childhood Children

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Abstract

This paper outlines the development and the analysis of an educational programme for children in early childhood education regarding the environmental issues like the saving of energy, natural resources and bioclimatic planning that attempt to introduce and link the principles of sustainability with society. The aim was the pupils to be aware of environmental issues and to promote the applications of sustainability in their real and social environment. The project took place in a kindergarten school in Thessaloniki, during the school year 2014-2015 with the participation of 15 students and was carried out through three phases: 1) the exploration of the subject, 2) the implementation of educational activities, and 3) the evaluation of the project. Children were introduced to all energy sources and be encouraged to think for and about the energy. The kindergarten teachers worked with the children, creating a proactive teaching environment with many appropriate stimuli, in order to motivate and facilitate their learning through play. At the same time, by keeping in pace with every single child's learning rhythm, the aim was to give them equal learning opportunities. This educational program was beneficial to all children as they learned new concepts and acquired new experiences.

Keywords: Sustainability, Energy Footprint, Creative Learning Environment, Project Method, Early Childhood Children.

Bionotes

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Introduction

The challenge that we are facing today in sustainable education is to teach for and about environmental issues as a part of the contemporary culture and society (UNESCO 2005). The Education for Sustainability Development attempts to develop a sustainable school, which is expected to become a body of changes in education and society. Through teaching and learning, structure, organization, politics and everyday practices, viable / sustainable school is expected to make people capable of shaping sustainable conditions and of adopting sustainable lifestyles (Pramling-Samuelsson & Kaga, 2008; Flogaiti & Liarakou, 2009). Moreover, the school itself will be a model organization that promotes sustainability and takes it into school life. Among the characteristics of a sustainable school these that are of particular importance are: a) the participation of students in the learning process, b) professional development focusing on school, c) partnerships and educational networks and generally d) holistic approaches, because they made the school a lively, dynamic and evolving learning organization (Agenda, 21:1999; Deri, 2005; Tamoutseli & Mitakidou, 2006; Rasmy, 2010).

Ferreira, Ryan & Tilbury (2006) in the *Whole-School Approaches to Sustainability: A review of models for professional development in pre-service teacher education*, support several characteristics of a sustainable school. More specifically, they believe that school administration poses sustainability as an integral part of the educational policy and planning while there is mutual cooperation among school, family and local community. It focuses on participatory learning approaches that promote skills and abilities of students for critical thinking, reflection, intercultural understanding, empathy, involvement and action and it incorporates the pillars (environment, society, economy and culture) of education for sustainable development across the spectrum of the school curriculum.

Moreover, the latent program reflects the key messages and ideas that are supported by the official curriculum and it enhances continuous professional development of teachers and school administration bodies. It incorporates holistic and systemic approaches to education for sustainability and it emphasizes in connecting learning activities with the local community. It is worth mentioning that it incorporates activities to control the ecological footprint of the school, which includes all the dimensions of sustainable development and participatory action research in the educational process and the transformation of teachers into researchers and educational and social change agents.

For the integration of sustainability principles in the school, there are several approaches among which are: interdisciplinary and multidisciplinary approach, communicative-experiential approach, systemic approach, holistic, global approach, proactive approach, socio-cultural approach, transformational approach, etc. (Shallcross et al., 2009; Mogensen & Schnack, 2010). In this work, however, we decided to use more holistic approaches because they operate horizontally and enable schools to innovate and change the practices for the development and improvement of the whole school environment (Shallcross & Robinson, 2008). Specifically, on the one hand, holistic school approach is a grid comprising a) collaborative school climate b) the practices of teachers with interactive features and reflection c) the interdisciplinary approach to teaching and learning d) connection with the community and e) improvement of the physical school environment. On the other hand, it is connected by many theorists of education with school development, holistic school approaches in combination with the whole development of

students, and the professional development of teachers (Henderson & Tilbury, 2004; Katsenou, 2012).

Investigating international and European programs, which are geared to the adoption of the above mentioned principles, there have been underlined features that focus on the vision for Sustainable School. We identified initiatives in several countries including the UK, Australia, New Zealand, where efforts are made to promote the sustainability in their school programs in the perspective of Sustainable School. For example, in Britain's schools, where the development of the "Sustainable Schools" program (Sustainable Schools) was launched in 2006, it is aimed the schools to constitute models of sustainability by 2020. The first steps of schools began in 2007 with the announcement of the framework for the DAC by the Ministry of Education (Department for Education and Skills-DFES). Of course, before this particular project, there had been promoted several other actions, such as the "Healthy Schools". The program focuses on three levels of school life: a) in the curriculum, b) in the school area, and c) in the school with the local community. Throughout the course of the process, we identify the dominance of the element of cooperation, both among the members of school and between the school with the local community and other schools in the country and the international community. The issues that schools deal with come from students' interests or they are related to negotiating broader social issues (e.g. equality, justice) (DFES, 2005).

So, in this paper we present an implementation for preschool pupils on sustainability issues through a three phases learning model that combines principles of science regarding the saving of energy and natural resources together with issues of the protection of the environment. The ultimate goal of the project work was to help the children realize the need to protect the environment, to enrich their knowledge on renewable and non-renewable energy sources, to reflect on the correct use of these and take action as active citizens in relation to their age and abilities, adopting appropriate attitudes and behaviors (Cassel & Giddens, 1993; Barth, 2002; Ministry of Education, 2003). Furthermore, the project aimed at allowing children to enjoy tales related to energy, to reflect on them, to make assumptions and draw conclusions. Additionally, the project enriched children's ability to find solutions on how to save energy, how to achieve knowledge on various types of fuel, such as oil, and to learn how those fuels are created. Children also enriched their knowledge and their vocabulary with new concepts, learned to cooperate and to present the outcomes of their team working. Finally, they developed their critical ability and were taught how to justify their opinions.

Methodology

The application of the developed work plan on energy resources and sustainability took place at the kindergarten school "Nipiakos Kipos", in Thessaloniki (Greece) during the school year 2014-2015 and has been completed within three sessions with the participation of 15 pupils, age 5 years old, incorporating various strategies such as the brainstorming, the role games, the collecting information method and the experiments (Thanou 2001; Ntoliopoulou, 2005). The idea was fostered and developed after reading "The curious thunderbolt that solves the energy problem", a book by Vaggelis Iliopoulos (Iliopoulos, 2010). Children were concerned about the utilization of renewable and non-renewable energy sources and expressed their queries, which we noted in order to gain further



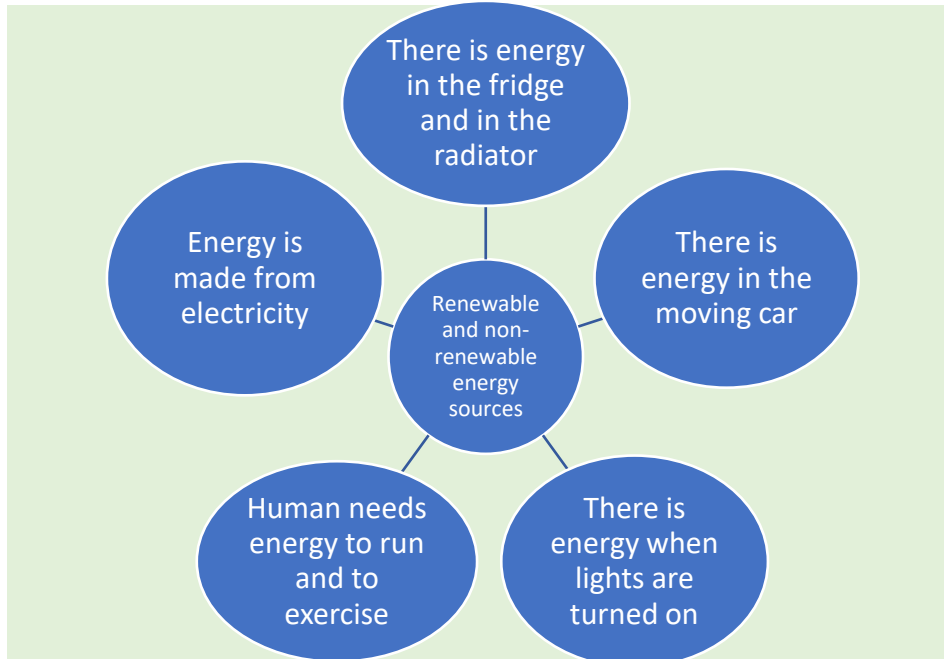
information. The project has followed three phases each of which were in accordance and led children to particular thoughts and realisations:

First Phase: The exploration of the subject

The first phase of the programme was devoted to the exploration of the subject and the navigation of the preschoolers to concepts and ideas. The first phase of the project includes speculation and definition of the subject, through discussions, exchange of information and questions, in order for children and kindergarten teachers to understand and elaborate the subject. Moreover, children discussed and exchanged information and did some brainstorming on the subject at the beginning. The goal was to enrich their knowledge regarding renewable and non-renewable energy sources, to reflect on several ways of using correctly these sources of energy and to adopt right attitudes and behaviours towards the idea of saving energy. The questions and suggestions of the children were investigated and recorded on the following histograms:

- Renewable and non-renewable energy sources
 - There is energy in the fridge and in the radiator
 - Energy is made from electricity
 - There is energy in the moving car
 - Human needs energy to run and to exercise
 - There is energy when lights are turned on

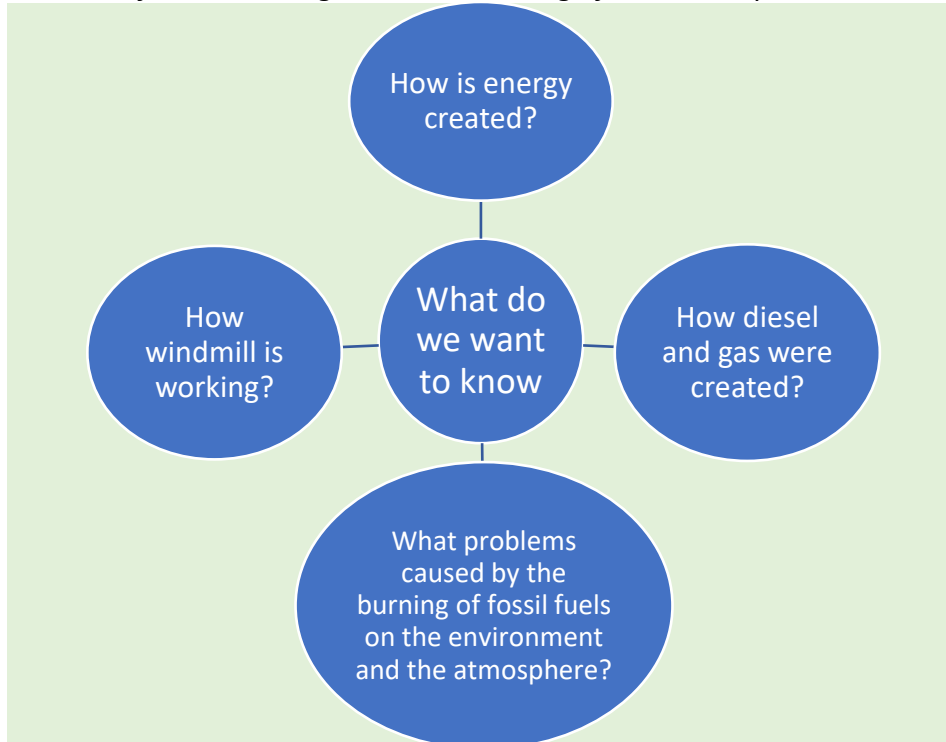
Creation of first histogram and recording of children's thoughts:



- What do we want to know
 - How is energy created?
 - How windmill is working?

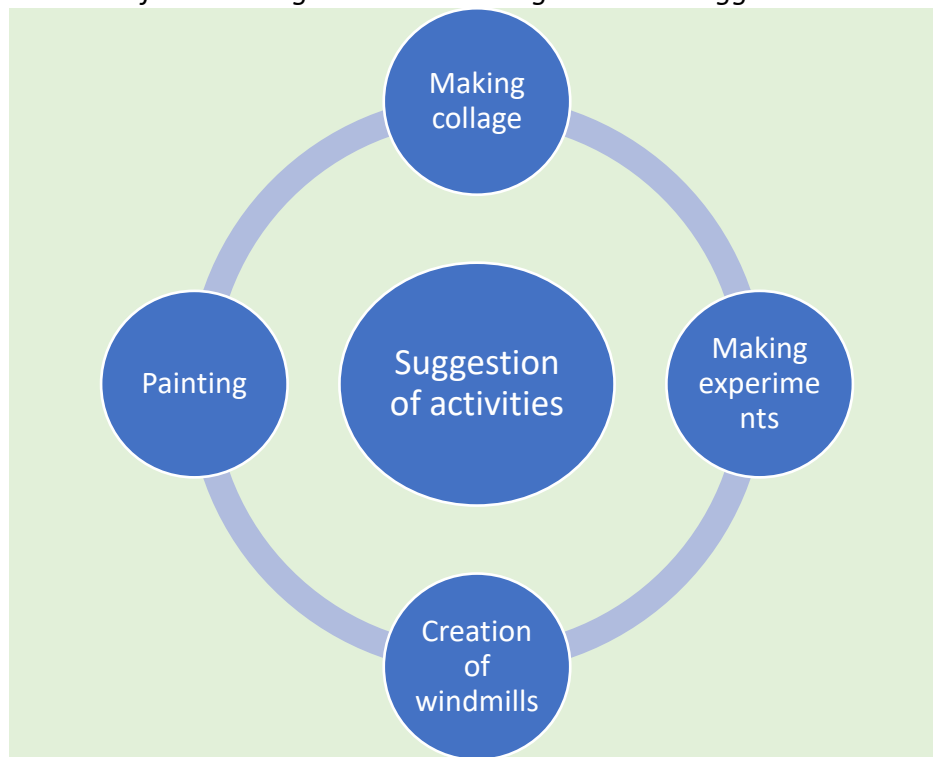
- How diesel and gas were created?
- What problems caused by the burning of fossil fuels on the environment and the atmosphere?

Creation of second histogram and recording of children's questions:



- Suggestion of activities
 - Making collage
 - Painting
 - Making experiments
 - Creation of windmills

Creation of third histogram and recording children's suggestions:



Second Phase: The implementation of educational activities

The second phase of the programme was related to the implementation of the educational activities. In this second phase, the teachers implemented various activities under Cross Curriculum Framework, and they expanded it through various fields such as language, mathematics, environment, creation, expression and computer with the aim for children to learn how to distinguish phonemes as words ingredient along with developing their reading and writing skills. As for the mathematics sector, the children were aimed at learning to classify, count and compare through mathematical concepts, work together and express themselves through improvisation which are important skills for this educational level. In addition to all these, children expressed themselves through art using different materials and colors to create windmills, the fostered their creativity and imagination, which are basic goals of the modern preschool education. In addition, they experimented, learned about static electricity, while they were using very simple materials and were able to understand the power of air and its correlation to wind energy in a stress-free environment that facilitated their effective understanding putting away their fears towards this “new” field of learning. They were taught how a traditional watermill works based on information, they surfed the internet and they visited several websites in their attempt to search for pictures of various energy sources so that they could realize certain concepts that they were not familiar with at that time.

It is worth mentioning that the activities, which were designed by the researchers and implemented to students during the second phase of this programme, are related to the following scientific fields and they are presented in detail:

LANGUAGE



Duration: 10 minutes

Materials: Cards that indicate various energy sources, cards with letters

Learning aims:

- Development of writing and reading skills
- Recognition of the phonemes as components of the words

Activity: Children were separated in groups and were asked to compose the words of various energy sources, by placing the cards with the letters in the correct order

CREATION AND EXPRESSION



Duration: 10 minutes

Materials: Fabrics and handmade hats from cardboard

Learning aim:

- Cooperation and expression, through improvisation and imitation

Activity: Children represent Aesop's fable "The sun and the wind"

ENVIRONMENT



Duration: 5 minutes

Materials: Balloon, wooden fabric, pieces of paper towel

Learning aim: To become familiar with basic research procedures

Activity: Children rubbed the balloon with wooden fabric and they placed pieces of paper towel on it, in order to experiment with static electricity

COMPUTER



Duration: 10 minutes

Learning aim:

- To get familiar with the use of computer as a supervisory learning tool

Activity: Children were informed about the operation of a traditional watermill, through videos on the internet and searched for pictures about different energy sources

Third phase: The outcomes of the project

The last phase of the programme was related to the evaluation of the project. This third phase consisted of three stages which were a) diagnostic evaluation, b) formative evaluation and c) overall evaluation.

More specifically, as far as the diagnostic evaluation is concerned, it is worth mentioning that the researchers studied the elicitation of children's knowledge, which is recorded on a histogram and determined that children could answer the question "Where is energy?" without being able however to define what is energy and how it is produced. The histograms were reviewed by kindergarten teachers and the children, in order for the kindergarten teachers to organize activities that would allow them to explore, experiment and answer children's questions. As for the formative evaluation, kindergarten teachers observed which of the questions had been answered and which children's positions were valid (first histograms). Also, it was determined that the children were able to respond to their initial questions. So, the results indicated that it was difficult for children to understand the concept of energy, but they understood when and how it is utilized in our everyday life. Regarding the overall assessment, it showed that children learned about the sources and forms of energy, they were encouraged to think ways of saving energy and they found experiments as the most interesting activity through which children asked questions, made assumptions and came up with conclusions. The project was completed with the construction of a poster, where messages about saving energy were recorded.



Conclusions/ Discussion

The estimation of the feasibility of this project demonstrated that this particular education programme was quite effective for preschoolers. Both the materials the educators made use of and the activities that were implemented in a careful way, helped children in matters of knowledge, skills and stances.

Through a sustainable school, we can manage to create a community of citizens who envision "another" school, foster reflection and develop their thinking. They take decisive steps to improve their life without burdening the life of other people or biodiversity. The analysis of the project reveals that when working in this creative environment, abstract science concepts transform and gain shape becoming integrated in activities for pupils. The application about energy footprint and sustainability offers a dynamic environment for science concepts to

“appear” in the real world and helps to develop original learning contexts. Individuals discuss, wonder and follow their own path to learning and understanding science.

This project could open new perspectives for creative and interactive learning on environmental issues and can be applied to many other science and environmental topics. Meanwhile, this educational programme could provide an incentive for further research and design on such projects not only at this education level but at upper education levels as well as in this way students could continually raise their awareness about environment issues that are of high importance nowadays.

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